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ABSTRACT BOOKLET

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INVITED SPEAKER:
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Méniere's disease is a not uncommon and most unpredictable disorder. There is an incidence of 4-50/100000 reported. Although the disorder is not lifethreatening per se it is most disturbing and the symptoms may lead to disability and even suicide. Also the natural course is extremely individual.. Most patients seem to stop having acute attacks within 5-10 years during which time span the hearing deteriorates (Friberg et at 1984).
Conservative treatment comprise a plethora of approaches where the majority has not been validated in controlled studies.,These include diuretics, vasoactive substances, betahistidin, salt restrictions, acupuncture, pressure trreatments and others. According to a survey in Britain 94% of surgeons prescribe betahistine, 63% diuretics and 71% advise salt restriction and 50 per cent may insert a grommet. If needed, 2/3rd would recommend the use of gentamicin (Smith et al 2005)In cases where conservative treatment fail, one has turned to surgical approaches such as saccus decompression, vestibular nerve section and labyrinthectomy.
As an alternative to surgical procedures after failure of conservative treatments topical treatments and especially gentamicin may be considered.
Instalment of ototoxic substances i.e. streptomycin, into the middle ear for treating Meniere's disease, was reported in 1957 by Schuknecht. It was abandoned due to the very high frequency of severe hearing loss. In 1977 Lange introduced the change to gentamicin with repeated instalments. He reported preserved hearing in 76% of patients. The procedure was spread slowly in continental Europe, later Japan and in Uk and US in the mid 90's.Initially doses were repeated once to several times daily, until there was signs of vestibular damage. In 1991 it was demonstrated that there was a delay of several days in the onset of the vestibular damage and the low dose therapy was introduced (Magnusson and Padoan, 1991, Magnusson et al 1991). This developed into two variations; where either 1-2 instalments were administered and the patient would be seen in 2-4 weeks or repeated instalment one week apart until signs of a reduced vestibular function appears. However, quite often patients reported severe and prolonged dizziness after the vestibular loss. To meet this problem we developed the 'vestibular prehab' algorithm where patients do vestibular and balance exercises for at least 2 weeks before instalments and continue doing them for 6 weeks past (Magnusson et al 1992, 2007). Most patients experience only slight or ignorable discomfort while losing vestibular function. With this approach, we control vestibular symptoms in 89% of cases, with severe hearing loss in only 2-3% and in most cases patients do not experience very much of the dizziness due to the vestibular loss.
In all Vestibular ablation with gentamicin, combined with pre and parallel vestibular adaptive training – 'Vestibular PREHAB' - is an effective treatment that present the possibilities of controlling attacks of vertigo, with a rather small risk of hearing loss and without prolonged dizziness.

Vestibular Evoked Myogenic Potentials in Bilateral Vestibulopathy

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Vestibular evoked myogenic potentials (VEMPs) assess the function of the saccule and the inferior division of the vestibular nerve. One would expect that VEMPs would be an efficient method of diagnosing bilateral vestibulopathy such as due to ototoxic medications. However, a recent study suggested that VEMP's were present in nearly all patients with bilateral vestibular loss (Zingler, Weintz et al. 2008). In this study we compared VEMPs in 19 normal subjects to those of 30 patients with bilateral vestibulopathy due to either gentamicin ototoxicity (n=16) or an idiopathic cause (n=14).

We found VEMP responses to be greatly diminished in patients with bilateral vestibular loss. The mean total VEMP response (left plus right p1-n1 interpeak amplitudes) in normal controls was 664.04 μV. In gentamicin patients the mean total response was 53.56 μV, and in idiopathic vestibulopathy patients, the mean total response was 64.06 μV. When responses were present, their latency was not significantly

affected. The total VEMP response correlated well with results of caloric and rotatory chair testing. We found no correlation between VEMPs and hearing.

Compared to the results of Zingler and associates (Zingler, Weintz et al. 2008), we noted a far greater separation between VEMP amplitudes in normals and patients with bilateral loss. Also different than Zingler, we found a strong correlation between caloric and VEMP total response. These differences may be largely due to our finding of larger responses in our normal population, and might also be due to a larger proportion of patients with more severe bilateral loss than studied by Zingler. Our results suggest that bilateral vestibular weakness affects both saccular function as well as canal function, and that the VEMP test is a good method of identifying bilateral vestibular weakness.

The Use of Vestibular Evoked Myogenic Potential Frequency Tuning Curves in the Diagnosis and Management of Meniere's Disease

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The cervical vestibular evoked myogenic potential (C-VEMP) is a surface potential that is generated by the saccule and can be measured at the sternocleidomastoid muscle in response to loud acoustic stimuli. The technique is becoming increasingly popular within the clinical environment as it allows assessment of the saccule and the inferior division of the vestibular nerve without causing discomfort to the patient. More recently a variant of the response known as the ocular VEMP (O-VEMP) has been reported. The O-VEMP is also generated by the otolith organs and is recorded at the contralateral inferior extraocular muscles. However the precise pathways involved remain at this stage unclear.

Recently it has been proposed that a potential clinical application for the VEMP responses is in the diagnosis of Meniere's Disease (MD). It has been suggested that the increased fluid pressures generated in MD lead to altered VEMP frequency response curves as the mechanical resonance of the vestibular apparatus is altered. In this paper we describe preliminary results from a prospective cohort study looking at the C-VEMP and O-VEMP tuning curves measured from patients with confirmed Meniere's disease as well as a control group of healthy ears. We examine the possibility of using a low/high frequency VEMP amplitude ratio as a criterion that could be used to aid in the diagnosis of MD. The sensitivity and specificity of such an approach is also investigated.

This research project is supported by the Meniere's Society, UK.

Vestibular Evoked Ocular Myogenic Potentials (oVEMPs) to Fz Bone Conducted Vibrations in Superior Vestibular Neuritis show utricular function

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500 Hz bone-conducted vibration (BCV) delivered to the midline of the forehead at the hairline (Fz) causes simultaneous and approximately equal amplitude linear acceleration stimulation at both mastoids. This stimulus activates otolithic neurons and results in a series of negative-positive potentials called the ocular vestibular evoked myogenic potentials (oVEMP) recorded by surface electrodes beneath both eyes. In healthy subjects the first component of this evoked myogenic potential at a latency of about 10ms is called n10 and is equal in amplitude beneath both eyes. 500 Hz BCV selectively activates otolith

irregular neurons, and the n10 component is due to a crossed otolith-ocular pathway. It has been reported that in response to Fz BCV, 12 patients with superior vestibular neuritis (SVN) had reduced or absent n10 potentials beneath the eye contralateral to the affected ear.

The objective of the present prospective study, carried out in a cohort of patients referred to our tertiary referral neurotological centre from October 2008 to March 2009, was to compare the responses obtained from a substantial number of patients with unilateral SVN to the responses of healthy subjects in order to confirm whether the earlier report is correct. For this purpose oVEMPs were collected from 133 SVN patients and compared with the results of 50 healthy subjects. oVEMPs were recorded simultaneously for both eyes in response to 500Hz Fz BCV using surface electrodes beneath both eyes. In SVN patients, n10 amplitudes were significantly reduced or absent under the eye contralateral to the affected side.

From the amplitudes of the n10 potentials beneath the two eyes an asymmetry ratio (AR) was calculated for each patient and subject. The average AR for healthy subjects was 7.3% ± 4.6. On the other hand the average AR for patients was significantly greater at 66.9 % ± 19.7 (*p >0,001)*. These results confirm that the amplitude asymmetry of the n10 component of the oVEMP is a new way of assessing otolith, and probably mainly utricular macula, function.

Head-mounted vibrotactile stimulation for bilateral vestibular loss: A Phase I FDA Clinical Trial"

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Postural instability in patients with bilateral loss of vestibular function is due in part to a loss of verticality due to absent otolithic input. Prior studies by Wall et al have shown that vibrotactile stimulation applied to the trunk can increase postural stability as measured by both static and dynamic posturographic measurements. In the current study, we evaluated the efficacy of a head-mounted accelerometer/tactor system in five severely vestibulopathic subjects while performing computerized dynamic posturography and eccentric rotational subjective visual vertical testing. Our results indicated that the addition of a vibrotactile stimulus proportional to head tilt in the pitch or roll plane significantly reduced the number of falls and increased the time to fall (TTF) on Sensory Conditions 5 and 6 on Computerized Dynamic Posturography but did not alter the subject's sense of verticality during eccentric rotation. Further studies are currently ongoing to evaluate this technique in subjects with varying degrees of vestibular loss, mild traumatic brain injury and multifactorial instability in the elderly.

The pathology of Meniere's disease lies in the bone surrounding the endolymphatic duct.

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The most important discovery in the understanding of the pathology of Meniere's disease was the finding of endolymphatic hydrops by Hallpike in 1939. Since then many further studies have attempted to determine a cellular basis for this hydrops, but none has been successful. While examining the endolymphatic duct and its environs in temporal bones from cases of Meniere's disease we found striking changes. In all temporal bones the inner skeletal layer of the vestibular aqueduct forms an arch-like structure closely wrapped around the endolymphatic duct throughout its whole course, including its intravestibular portion. This "arch" is filled with osseous canals formed by osteoblasts, which seem to break down to a mild degree normally, probably as a homeostatic mechanism in the formation of

endolymph. In the temporal bones of 20 cases of Meniere's disease we identified massive breakdown of these cells leaving the canals of the arch exposed. We suggest that the hydrops of Meniere's may be caused by this change. Future successful therapy of Meniere's may arise from experimental work on the molecular basis of this pathology.

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L. Michaels, S. Soucek & F. Linthicum. The intravestibular source of the vestibular aqueduct. II: Development and function of the intraskeletal channels of the otic capsule (including the *fissula ante fenestram),* and their involvement in the osseous pathology of Meniere's disease. Under review for possible publication in Acta Otol-Laryngologica. Also presented to the 32nd Midwinter Research Meeting of the Association for Research in Otolaryngology, February 2009

Monothermal Caloric Testing in the Screening of the Dizzy Patient

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Objective: The alternate binaural bithermal caloric test (ABBT) is the standard, well-established examination in the evaluation of the dizzy patient. Monothermal caloric testing (MT) has the potential benefits of reducing the administration time and patient discomfort. The goal of the present study was to investigate the role of MT screening in the prediction of ABBT results. *Study Design:* Retrospective and prospective data analysis. *Methods:* ABBT results of 218 patients having normal otoneurological examination, normal hearing, and normal Electronystagmography (ENG) were retrospectively analyzed to generate norms for each of the four ABBT sub-tests and side difference for the warm and cold MT. These norms were then employed to calculate the sensitivity and specificity of MT for predicting normal ABBT in a group of 197 consecutive dizzy patients who were referred for vestibular testing. *Results:* The best predictions of ABBT by MT results were achieved when ENG testing showed oculomotor integrity, no spontaneous, positional and positioning nystagmus. Under these conditions, warm MT lateralization < 31.6% had 90% sensitivity and 92% specificity for the prediction of normal ABBT. *Conclusions:* When no pathology is detected in the other parts of the ENG, warm MT lateralization < 31.6%, can indicate normal ABBT with a 10% probability for a false-negative result. Higher sensitivity may be achieved by lowering the cut-off point of the response asymmetry required for the diagnosis of MT screening failure and the omission of directional preponderance diagnosis from the goals of the screening.

Failure of OAE suppression: a characteristic of some patients with migrainous vertigo

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Hypothesis:
Sensory dysmodulation in audiovestibular brainstem reflexes in patients with migrainous vertigo can be demonstrated by studying transient evoked otoacoustic emissions (OAEs) and their contralateral suppression.

Methods:
The authors measured OAEs with contralateral suppression according to an established protocol[1] in a group of 35 patients with definite migrainous vertigo, and compared them with age and sex matched non-migrainous controls.

Results:
OAE suppression was demonstrated clearly in both groups with a normal value of 0.6 dB. A higher than expected proportion of patients showed high TEOAE amplitude (24%, p=0.001) or low OAE suppression (31%, p=0.01) in at least one ear, but the mean value of OAE suppression was no different between patients and controls.

Conclusions:
Reduced OAE suppression is seen in MV and could be due to a loss of a sensory modulation mechanism in keeping with current theories of migraine pathophysiology, and is seen in around a third of cases.

Differentiating malingering patients from healthy controls, unilateral vestibular loss patients and whiplash patients.

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Introduction:
Differentiating non-organic balance disorder patients (malingerers) from those with organic balance disorders is difficult and costly. We examined whether objective criteria based on trunk sway measures recorded during stance and gait tasks can aid this task.

Methods:
Trunk sway angle and angular velocity in the roll and pitch plane was measured with a SwayStar™ system during several stance and gait tasks (maximally 14) in 18 patients suspected of malingering. Their data was compared with that of 20 patients who had suffered a unilateral peripheral vestibular loss 3 months earlier, 20 patients with documented whiplash injuries, and 35 age- and sex-matched healthy controls. Stepwise discriminant analysis was used to determine variables and criteria which best differentiated malingering patients from the other sample populations. Variables were chosen from among those showing significant differences between the populations.

Results:
Classification results appeared best for criteria or variables based on 90% sway values (excluding the upper and lower 5% of sway) and ranged from 72% (for all four groups) to 96% (malingering versus controls). Criteria that were important for this discrimination were the difference in roll velocity during standing on 2 legs with eyes closed on a foam and on a firm surface, and the difference in pitch velocity during tandem steps and standing on 1 leg. The variable pitch velocity for standing on 2 legs with eyes open on firm surface was also selected.

Conclusions:
Discriminating suspected non-organic balance disorder patients from either those with organic disorders or healthy controls is possible by using objective criteria based on trunk sway measured during several stance and gait tasks.

Vestibular perception after acute vestibular neuritis

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Background
Although vestibular testing focuses on brainstem reflex function eg. the vestibular-ocular reflex (VOR), these tests are poor predictors of a patient's long term recovery after vestibular injury. This study investigates vestibular perception and VOR function during the acute and recovery stages after vestibular neuritis, in order to understand cortical involvement in the compensation process.

Method
Vestibular neuritis patients were tested acutely (<1 week; n= 20) and at 6-8 weeks; n= 13. Vestibular perceptual time constants were investigated during 90˚/s velocity steps in the dark, with subjects indicating their perceived angular velocity via a flywheel linked to a tachogenerator. VOR was simultaneously recorded via EOG. Questionnaires measured symptom load and psychological status.

Results
Normal time constant values for ocular and perceptual responses are ~16s (Okada et al, 1999). Acutely, perceptual time constants in patients were bilaterally but symmetrically reduced (contralesional 7s; ipsilesional 7s), with oculomotor time constants asymmetrically reduced towards the lesioned side (contralesional 11.4s; ipsilesional 8.7s). At follow up perceptual and ocular time constants increased, with perception remaining symmetrical (contralesional 9.9s; ipsilesional 9.3s), and oculomotor asymmetrical (contralesional 15.2; ipsilesional 12.8s). Questionnaire data showed progressive symptom reduction in all patients.

Conclusions
The 'dampening down' of vestibular time constants represents a protective compensatory mechanism capable of reducing ocular instability and vertigo. The extreme shortening and symmetry of perceptual time constants indicates an additional compensatory cortical process, apparently more efficient than low level brainstem VOR mechanisms.

Advances in vestibular rehabilitation: high-tech vs. low-tech optokinetic stimulation and the role of supervision

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INTRODUCTION:

Customised vestibular rehabilitation incorporating optokinetic stimuli via whole-body or visual environment rotators is more beneficial than the former in isolation for improving dizziness, postural instability, and particularly visual vertigo in patients with a chronic peripheral vestibular disorder [1]. The equipment used though is expensive and the twice weekly therapy sessions are not standard practice where patients often do their exercises unsupervised. The purpose of this study is to do a controlled between-group comparison of patients' responses to a customized exercise regime incorporating exposure to optokinetic stimuli via a full field visual environment rotator (Group A) or on a DVD with (Group B) and without supervision (Group C).

METHODS:
Sixty patients with chronic peripheral vestibular disorder who had previously undergone conventional vestibular rehabilitation without notable improvement were randomly allocated into Group A, B or C. Group A and B attended once weekly therapy sessions for eight weeks and were also provided with a customized home exercise program including physical exercises and the DVD. Group C were given a

customized home exercise program and the DVD to do unsupervised for eight weeks. Treatment response is assessed at baseline and eight weeks with dynamic posturography, Functional Gait Assessment (FGA), and subjective questionnaires for symptoms, symptom triggers, and emotional state. RESULTS: Fifty-five percent of Group C patients do not complete the trial compared to 10% for both Group A and B. Two-way ANOVA analysis shows significant improvements for all outcome measures ($p < 0.05$) but no significant differences between groups. Statistical analysis on within-group data shows significant improvements for all groups for global vertigo, visual vertigo, and autonomic symptom scores, although Group A and B show greater improvements ($p \leq 0.01$). Posturography and FGA scores significantly improve only for Groups A and B ($p \leq 0.01$). Anxiety scores significantly improved only for Group B ($p < 0.05$) and depression only for Group A ($p < 0.05$); no change was noted for Group C.

CONCLUSIONS:
The DVD is an effective and economical method of incorporating optokinetic stimuli into vestibular rehabilitation programs. However rehabilitation must be supervised for greater compliance and improvements, particularly for balance, gait and emotional state.

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SHORT PAPER SESSION

Minor symptoms, major pathology.

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ABSTRACT: 4 cases will be presented in which relatively subtle
symptoms of imbalance were the result of major (and unusual) pathology.
In each case, a "standard examination" failed to identify a problem and patients were falsely reassured. These cases highlight the importance of carrying out a thorough neuro-otological examination in the out-patient clinic, informing appropriate and selective investigation, in preference to the "blunderbuss" approach to requesting imaging and other special tests.

Looking beyond and across the (y) ears
(A case of Endolymphatic Hydrops associated with primary hyper Aldosteronism.)

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OBJECTIVE :We present a rare case of an adult female referred to the Neuro-otology department, at the RNTNEH, with bilateral hearing loss and tinnitus, who was found to have previously undiagnosed bilateral Endolymphatic Hydrops associated with Primary Hyper-Aldosteronism (Conn's syndrome).

RESULTS: A 57 year old female was referred to the Neuro otology department in 2005(age 52) for further investigations and management of bilateral hearing loss and tinnitus. At the time of presentation the patient had no residual hearing on the right side and moderate to severe hearing loss on the left side. A detailed history revealed that the patient had sustained a sudden hearing loss in the right ear with associated tinnitus and rotatory vertigo at the age of 22yrs. Her hearing never recovered and she was also left with right side tinnitus but no symptoms of vertigo. At the age of 36 she experienced a sudden hearing loss on the left side with similar associated symptoms of tinnitus and rotatory vertigo. She was admitted to hospital where she had treatment with steroids and vasodilators and her hearing in the left ear was partially recovered. The third episode, of sudden left side hearing loss, was at the age of 51, 8 weeks post laparoscopic adrenalectomy for primary hyper Aldosteronism (Conn's syndrome), diagnosed

following investigations for labile hypertension (formal diagnosis of hypertension, age 38) and hypokalaemia. Careful questioning revealed that following the third episode the patient was left with fluctuation of hearing loss, aural fullness, tinnitus and recurrent rotatory vertigo. Clinical examination revealed abnormal performance on Unterberger test and vestibular assessment revealed 1st degree left gaze nystagmus in the absence of fixation and reduced vestibular input with incomplete central vestibular compensation. Haematological and radiological examinations (MRI / CT) were reported as normal. The patient was diagnosed with bilateral Endolymphatic Hydrops and her symptoms were managed by dietary measures and medication (following consultation with her endocrinologist), prior to rehabilitation by a Multidisciplinary team which included also an audiologist, hearing therapist, clinical psychologist and vestibular scientist.

CONCLUSION: This case illustrates the importance of early diagnosis of Endolymphatic Hydrops in order to prevent irreversible Audiovestibular changes and the value of a detailed clinical evaluation in doing so. It also demonstrates the advantage of a multidisciplinary team approach in rehabilitation of patients with Audiovestibular disorders and highlights the importance of adopting a holistic approach to both the assessment and management of these patients. An extensive review of published literature will be outlined showing that there are Aldosterone receptors in the inner ear and that experimental studies have shown a relationship between Endolymphatic Hydrops and hyper Aldosteronism and the need for further research on this subject.

Metastasis in the Cerebellopontine angle

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Metastases to the cerebellopontine angle are very rare. We present our series of three patients, their management and a review of the literature. Primary sites include: breast, lung, gastro-intestinal tract, genitor-urinary tracts, bone, thyroid, head and neck, paranasal sinuses, skin, and haematological malignancies.[1] Patientsoften present with rapid onset of unilateral or bilateral hearing loss, vertigo, otalgia, facial paralysis, headaches, diminished corneal reflexes, diplopia, and other cranial neuropathies. Patients often have a preceding history of cancer although this is not always the case.

The history and examination are vital in raising suspicion of metastases as these patients often prove a diagnostic dilemma. Caloric testing often shows a canal paresis on the affected side. Metastases are difficult to differentiate from vestibular schwannomas on magnetic resonance imaging, and they can even coexist.[2] The diagnosis may be made by finding neoplastic cells on lumbar puncture.[3] This involves much less morbidity than surgery in a patient group with limited survival.

Treatment may involve translabyrinthine excision as the hearing has often already been lost. This achieves a diagnosis and may partially remove the tumour. Prolonged survival after resection of metastatic adenocarcinoma of the breast to the cerebellopontine angle has been described but more often the prognosis is poor and patients will have been exposed to unnecessary morbidity.[4] Alternatively, some patients benefit from whole brain irradiation therapy. Patients with metastatic prostatic carcinoma may have complete resolution of their cerebellopontine angle lesions with the use of hormonal therapy.[5]

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Not so benign positional vertigo

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Two patients presented with history suggestive of BPPV and were subsequently found to have posterior fossa lesions on brain scans. The first patient reported episodic positional vertigo lasting seconds with intractable vomiting. Hallpike's manoeuvre was positive for posterior canal BPPV on both sides but the patient was unusually sick. The scan in this case was performed due to associated unusual vomiting. The second patient presented with spinning vertigo on lying down and neck hyperextension but would also have episodes of collapse and possible loss of conscience. The Halpike manoeuvre was negative. General neurology review and CT scan were initially considered unremarkable. After a further episode of collapse a posterior fossa lesion was detected on MRI. These two cases emphasize the need to pay attention to associated symptoms in patients with a prima facie diagnosis of BPPV.

A world that is constantly jumping

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Abstract: We present the case of a 64 year old lady with a 10 year history of brief but very frequent episodes of vertical and rotatory diplopia, during which she feels as though "the world is jumping". Her symptoms have remained refractory to treatment and occur upto hundreds of times a day. We discuss the clinical findings and investigation results in this patient, and summarise treatment options for the condition.

INVITED SPEAKER:
Intratympanic drug application in Menière's disease – choice of treatment and their effects

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The pathophysiology of Menière's disease (MD) is still not completely understood. For this reason,therapy is in most cases based on the experience of the individual clinician. At present, one of the most promising therapeutic options is the intratympanic application (IA) of gentamicin and steroids.
Recent measurements of drug concentrations in the inner ear after IA of steroids (Plontke and Salt, 2007) provide some insight into the pharmacodynamics. On the basis of these data a mathematical approach has been developed to calculate the dynamics of drug distribution in the peri- and endolymphatic fluid compartments of the cochlea and vestibular labyrinth. While it is clear that IA proceeds via the round window niche, the exact pathway of how the drugs enter the fluid compartment of the inner ear is still under discussion. The main practical aspects of IA are 1) the method of anaesthesia of the tympanic membrane, i.e. topical use vs. infiltration of local anaesthetics to perform the application and 2) the type of drug application, i.e. long-term delivery vs. single shot dose.
While post-treatment observations after gentamicin application have confirmed long-term success of the therapy of vertigo attacks, our own results indicate distinct differences in the post-treatment recuperation

interval. Apart from the influence of different vestibular rehabilitation regimes, this could be related to the different sensitivity of the sensory cells of the semicircular canals and the otolith organs.

POSTER PROGRAMME

1.Autonomic Reactivity in 'Dizzy Patients': Motion Sickness Susceptibility and Cardio-Vascular and Respiratory Responses to Caloric Irrigation

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Introduction Vestibular signals contribute to the control of cardiovascular function and respiration and certain patterns of vestibular simulation, experienced in vehicles, are the cause of motion sickness (MS). Therefore, our study addressed the hypothesis that vestibular disease may be reflected in changes in normal autonomic reactivity.
Subjects The study cohort included 30 normal subjects, 20-78 years, and 103 patients, aged 15-79 with symptoms of dizziness suggestive of vestibular disease. 36 patients received a diagnosis of vestibular disorder. 25 patients had +ve vestibular test results (calorics, head shaking and rotation testing). In 14 patients test results did not concur with diagnosis (typically in BPPV).
Methods Reported symptoms, heartrate (HR), blood pressure (BP) and respiration frequency (RF) were obtained throughout hot and cold, clinical caloric testing. The predictive value of child MS susceptibility rating (MSSR) in indicating ***normal*** adult susceptibility was exploited by comparing current susceptibilities with childhood predictions for all subjects.
Results Approximate 1/3rd of subjects showed a pressor response to calorics, 1/3rd a depressor response (-12 -+20 bts/min; -12-+25mmHg mean BP) and 1/3rd were unaffected and with no differences in prevalence between subject groups or sub-groups. Changes in BP and HR with calorics co-varied linearly (r=0.9) (showing that normal auto-regulation was maintained). FR decreased in ¾ of patients by up to 0.13Hz and increased by a similar magnitude in the remaining ¼. Normal subjects had a similar distribution of changes but with magnitudes up to 0.3Hz.
5 point scale rating of nausea developing during calorics correlated with MSSR similarly for all subjects (r=0.5-0.6) but it was clear that caloric response and MS susceptibility could be dissociated in individuals. Two patients experience respiratory distress and vomited after calorics. Three patients developed migraine.
Childhood MSSR predicted current MSSR in normal subjects and patients with –ve test results (r=0.7-0.8). The correlation fell with marginal significance to r=0.5 in patients with +ve test results due to a significant change in MSS from childhood status in certain individuals.
Discussion Autonomic reactivity is comparable with normal controls in the majority of dizzy patients regardless of identified vestibular pathology although isolated individuals show a shift in MSSD. Marked autonomic reactivity observed in a few individuals studied may itself have been the cause of dizziness symptoms rather than an effect.

2.Cellular therapy for Hearing Loss, closing in on Reality

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Sensory neural hearing loss (SNHL) cannot be compensated by endogenous repair mechanisms and may eventually lead to permanent deafness. It is an increasingly significant health problem with wide psychosocial and economic implications. Current technology based treatment regimes do not yet replicate the complex biological system and furnish a full permanent solution. This has driven the development of cell therapies with the promise to replace degenerated inner hair cells in SNHL and ultimately reverse the natural progression of the disease. Studies have identified stem cells in the inner ear of mice, demonstrated cell survival, cell differentiation, and shown positive expression of markers

when transplanted in experimental animal models. However little attention has been paid to the problems of repeatably realising therapeutic cell populations under good manufacturing practice (GMP) compliant conditions suitable for cost effective mass treatment. Automation of cell culture improves process capability by removing variation and allows culture scale up and out, we consider this is key to providing a surrogate population capable of taking over the function of resident degenerated/diseased inner hair cells.

Currently there is no definitive cell source and differentiation protocol to facilitate such a development. Challenges include: the limited criteria for the measurement of therapy functional performance; appropriate cell sources that can be differentiated and expanded to clinically relevant numbers with the requisite function; and, integration of the engrafted cells post transplantation with the native cells for optimal clinical outcomes. Also, the petite space where the cells need to be transplanted, requires the development of novel surgical delivery techniques before a cell based therapy can be translated from a promising experimental modality to a clinical reality. Such a therapy must also necessarily be compared with the incumbent. For this logical and statistically significant animal and clinical studies replicating the clinical problem and demonstrating efficacy and ultimately cost effectiveness need to be detailed. In parallel with such work in fundamental science there is also a requirement to create in a timely way the enabling clinical and necessarily, commercial infrastructure that will allow the realisation of these therapies. In addition to the key steps of bench to bedside translation captured by the trajectory of technology readiness it is necessary to create a viable value network that will enable the commercial supply of the therapeutic at an acceptable cost of goods. Clinical application is coupled with a viable product, enabling technology or service based business model that allows successful supply and ultimately widespread adoption.

3.The relationship between positional vertigo and visual dependency.

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INTRODUCTION: It is not known if the increased visual dependence present in some patients with chronic vestibular symptoms is a life-long trait or whether it is secondary to the vestibular vertiginous symptoms. The underlying question is whether visual dependence is a neural plastic phenomenon that can be modified by vestibular excitation or dysfunction. In order to address this question we measured visual dependence, before and after Hallpike (and repositioning procedures if appropriate), in patients with active BPPV and in two control groups.
METHODS: We studied 20 BPPV patients with a positive Hallpike plus repositioning treatment (mean age 60 years ± 14 years SD), 20 patients with symptoms suggestive of BPPV but in whom the Hallpike manoeuvre was negative (mean age 53 years ± 14 years SD) and 20 age-matched normal control subjects (mean age 55 years ± 12 years SD). The tests [1] included the rod-and-frame test and the rod-and-disc test (both seated) which measure the degree of tilt of a visual vertical line, induced by a static frame tilt or a roll motion rotating disc, respectively. In addition we measured the amount of body sway path induced by the roll motion disc (subjects standing). Symptom load was measured with the Dizziness Handicap Inventory, the Vertigo Symptom Scale and the Vertigo Situational Questionnaire (visual vertigo).
RESULTS: Statistically significant results are: After the positional maneuver the +ve Hallpike group sway more with eyes closed (increased Romberg quotient). Both patient groups sway more with the rotating disc than normal subjects. Contrary to our initial expectations the amount of sway induced by the rotating disc decreases in normal subjects and in +ve Hallpike patients (but not in –ve Hallpike) during the second exposure (practice or habituation effect). Rod-and-disc and rod-and-frame effects (ie visual dependency) increase with age, in all groups.
CONCLUSIONS: Visual dependency is age dependent; this may partly contribute to the worse clinical outcomes reported in the elderly after vestibular disorders. Subjects with vestibular symptoms are more unstable than normal subjects when presented with disorientating visual stimuli; the effect is stronger in more symptomatic subjects and in the presence of visual vertigo. Regarding the original question that prompted this study, we failed to induce a significant increase in visual dependence by means of a single BPPV attack. This implies either that longer periods of vestibular stimulation or dysfunction may be required to modify visual dependence or that the increased visual dependency observed in chronic

dizziness and visual vertigo is a pre-morbid trait. Separate data with the rod-and-disc in patients with acute vestibular neuritis (Cutfield et al, this meeting) support the former hypothesis. The reduction in disc effects after the positional maneouvre can only be explained as a practice or adaptation effect; this is an encouraging clinical finding because it implies that visual dependence can be improved by repeated exposure to the visual moving stimuli.

4.Validation of the Social life & Work Impact of Dizziness questionnaire (SWID).

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Background: Although dizziness is a common symptom in general and hospital practice, its impact on the social and work life of dizziness of patients has been little studied. The aim of this study was to provide validation data for the new 'Social life & Work Impact of Dizziness questionnaire' (SWID).
Methods: The SWID questionnaire and a standardised quality of life questionnaire EuroQOL were given to a sample (n=43) patients attending 'dizzy patient clinics' (Neuro-otology) and to an opportunity sample of normal controls (n=45), of equivalent age distribution and gender ratio. Locations were London and Siena on a 50:50 split. Scale scores computed were the SWID4 (work, social, family, travel difficulties due to dizziness), and the EuroQOL five item scale QOL5. The EuroQOL current Health State visual analogue scale (HLTH) was analysed separately. Parametric and non-parametric statistical analyses were used as appropriate.
Results: There were no significant differences on any variable between the London & Siena and the samples were combined. The SWID4 scale had good reliability with a Cronbach's alpha = 0.85. Age (Mean (SD) years) was equivalent for patients (56.6 (18.0)) and controls (52.2 (18.0)) (p=ns). Gender ratios were equivalent for patients (17M 26F) and controls (15M 30F) (p=ns). Slightly over half of patients vs one third of controls were unemployed or retired ($p<0.05$). Four patients and no controls had given up work completely due to dizziness (Fisher exact $p<0.05$). Work ($p<0.001$), Social ($p<0.001$), Family ($p<0.001$) and Travel ($p<0.001$) difficulties due to dizziness were higher in patients vs controls. Similarly the SWID4 ($p<0.001$), QOL5 ($p<0.001$) and HLTH ($p<0.001$) scores were worse in patients vs controls. The SWID4 correlated with QOL5 ($r=0.50$ $p<0.001$), with HLTH ($r=0.31$ $p<0.01$). Retired participants somewhat 'diluted' the work difficulty item. If this was dropped then the correlations rose to $r=0.6$ & $r=0.5$ respectively.
Conclusions: The significant differences in the expected direction between patients versus controls for the SWID provide validity evidence for this questionnaire. In addition the significant associations with a well standardised questionnaire EuroQOL provide further support for the validity of the SWID questionnaire.

5.Effects of Vibrotactile Feedback on Stepping Balance Reactions in Young, Healthy Elderly and Parkinson's Disease Patients

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Background:
Patients with Parkinson's disease (PD) have a high incidence of falling due to their inadequate stepping response (Horak *et al*., 1992; Jacobs *et al*., 2005). The purpose of the present study is to evaluate the effects of the vibrotactile feedback (Asseman *et al*., 2007) in enhancing the quality of the protective stepping response of PD patients.

Methods:
Nine PD patients (mean age 66.3±9.2 yrs; 8 in Hoehn-Yahr stage 1-2, 1 in stage 3), nine healthy elderly (mean age 66.1±10.5 yrs) and nine healthy young (mean age 27.4±2.7 yrs) volunteers were recruited in the study. Subjects were instructed to stand on a motorized, computer controlled moving platform.

Unpredictable acceleration of the platform, either forwards or backwards, perturbed subjects' balance, requiring a protective step to maintain balance. Subjects wore an elastic cap which incorporated two DC pancake vibrating motors, as used in mobile phones (frequency ≈ 200 Hz). Vibration of the forehead or occiput motor prompted subjects to take a forward or backward step respectively. Stepping reaction time (SRT) and length of the first protective step during the perturbation were analyzed.

Results:
The SRT analysis showed no significant difference among the three groups when taking forward or backward steps. There was also no significant difference between with and without vibration feedback during the perturbation within each group. However, there was a decreasing trend in SRT in stepping forward with vibration in Parkinson's patients as well as a decreasing trend in SRT when stepping backward with vibration in the elderly controls. Fig. 1 shows that a longer SRT is found in the advanced PD (H-Y = 3) patient (forward stepping with vibration: 0.51 s, backward stepping with vibration: 0.27 s) compared to healthy young and elderly controls.

Considering step length, there was no significant difference among the three groups, forwards or backwards, nor with and without vibration. The healthy young subjects however, took longer steps than the healthy elderly controls and PD patients. Each group also produced shorter backward steps than forward step length. Fig. 2 indicates that the advanced PD (H-Y = 3) patient's step length is shorter when taking a forward (13.04 cm) or backward step (19.55 cm) with vibration, compared to healthy young and elderly controls.

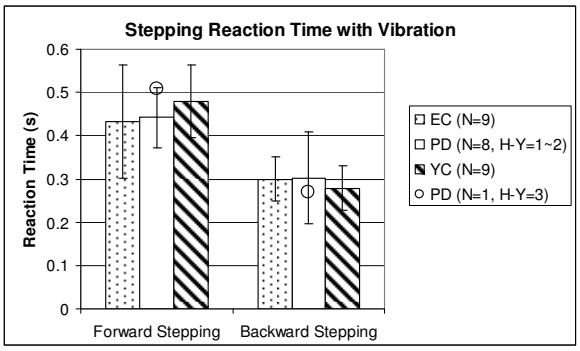

Fig. 1 SRT with vibration

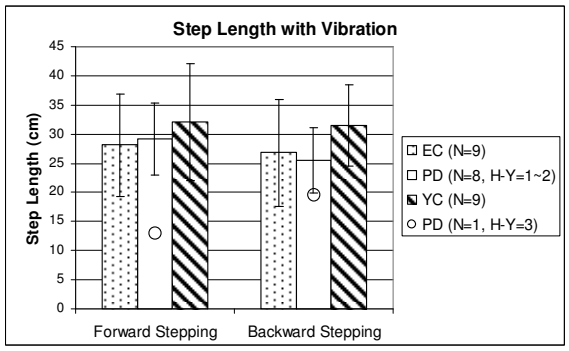

Fig. 2 Step length with vibration

Conclusion
The results show no significant group differences on stepping quality or vibrotactile feedback effect. However, this could be due to the small sample size used and the fact that most PD patients were not severely impaired. The more advanced PD patient examined showed abnormally slower SRT and shorter steps that would put him at a fall risk. Further work should concentrate on this group of patients.

6.Interaction Between The Vestibular-Spinal And The Cortico-Spinal Systems – A Caloric And Tms Study

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Postural control involves cortical and brainstem pathways but this interaction has only rarely been investigated experimentally. Here we report the results of the first study combining cortico-spinal and vestibulo-spinal activation by means of transcranial magnetic stimulation (TMS) and vestibular caloric stimulation respectively. Corticospinal excitability was recorded in 9 subjects by surface electromyography obtained bilaterally from Splenius capitis (SP), Sternocleidomastoid (SCM), Obliquus externus abdominis (EO), Biceps femoris (BF), Vastus lateralis (VL), Peroneus Longus (PL) and Tibialis Anterior (TA) muscles in response to TMS of the motor cortex. A double cone TMS coil was used to

deliver suprathreshold stimuli during baseline and caloric irrigation periods whilst subjects lied down supine on a tilted couch with their head at 30deg above horizontal (to vertically orientate horizontal semicircular canals). Of the muscles that showed a consistent pattern of asymmetric activation during voluntary isometric contraction in resisted rotation only SCM showed caloric-induced asymmetric modulation of motor evoked potentials (MEPs). The caloric stimulus induced slow phase eye movements towards the irrigated side together with increased SCM MEPs on the side contralateral to the irrigation and diminished MEPs ipsilaterally. This modulation was in the expected direction to mediate a coordinated vestibularly induced eye and head turn. These results, 1) show a new technique to examine vestibulo-cortico-spinal interactions in man, 2) demonstrate a prominent ocular-cervical coupling under vestibular control, 3) suggest a lesser degree of vestibular influence on infra-cervical spinal levels (at least for the horizontal semicircular canal system examined herewith). The vestibulo-cortico-spinal convergence found may provide the physiological basis for the adaptive neural plasticity observed after unilateral vestibular lesions, in that the catastrophic postural disorder observed acutely recovers rapidly in a few days. Whether the neural convergence observed in this study occurs at a spinal, cortical or multiple levels deserves further investigation.

7.Vertigo affects human visual cortical activity

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The visual and vestibular systems, either independently or in combination, are important for our ability to detect self-motion. Although complimentary, the two systems may conflict, e.g. when we see a train move past, we may sense self-motion rather than object motion. The brain may resolve this visuo-vestibular conflict via a reciprocal inhibition between visual and vestibular cerebral cortical regions and this concept is supported by functional neuroimaging, a correlational technique. We investigated visuo-vestibular interaction directly by measuring visual cortical excitability in area V5 using Transcranial Magnetic Stimulation (TMS) during vestibular activation in 6 volunteers. Vestibular activation was obtained via cold water (30deg) caloric irrigation. Subjects lay in the face-down position during the experiment to allow ease of access to the occiput. The intensity of a single TMS pulse required to elicit a Phosphene (a flash of perceived light produced by stimulating visual cortex) is a measure of visual cortical excitability. We titrated the TMS intensity to a fixed level per experimental session (4 sessions per subject) whereby 20 TMS pulses (inter-pulse duration of 6s) elicited 10 phosphenes (out of 20 pulses) i.e. a baseline phosphene probability of 0.5 (in reality we obtained a phosphene probability of 0.53). We then applied 3 further trains of 20 TMS pulses at the same intensity and stimulus interval (6s) as baseline; i.e. during (i) caloric-induced vertigo (ii) recovery period 3mins post caloric irrigation (iii) a final recovery period 6mins post caloric irrigation. We compared the probability of producing a phosphene during vertigo and the 2 recovery phases as compared to baseline. In summary we found that the probability of detecting a phosphene was : Baseline - 0.53 and Vertigo - 0.46 ($P<0.001$; chi square). The phosphene probability returned to baseline in the recovery period. These results suggest that vestibular activation results in inhibition of visual cortical area V5.

8.Vertigo as a migraine trigger

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Background: It is reported in some individual patients that vestibular stimuli can trigger migraine attacks. This study used a case-control design to examine systematically the hypothesis that vertigo induced by vestibular stimulation (rotation/caloric testing) can act as a specific migraine trigger.

Methods: 123 new patients attending Neuro-otology or Neurology clinics were studied with questionnaires and physician interview to ascertain migraine history according to International Headache Society criteria. 79 who underwent rotation/caloric vestibular testing ("test group") were compared with 44 control patients in whom no such testing was carried out ("control group"). The principal outcome measure was the occurrence of a migraine attack within 24 hours of exposure to vestibular stimulation.
Results: Of those participants with a past history of migraines, 19/39 (49%) of the test group experienced a migraine in the study time window, compared with 1/21 (5%) of the control group. Binary logistic regression analysis confirmed that vestibular testing was associated ($p<0.05$) with migraine attacks.
Conclusions: The results indicate that induced vertigo can act as a migraine trigger, a finding with implications for the diagnosis of patients with episodic vertigo and migraine headache. Whilst such patients may well have basilar migraine or migrainous vertigo, alternatively another disorder causing episodic vertigo (e.g. benign paroxysmal positional vertigo or Menière's disease) may be triggering migraine headaches.

9.Variations in presentation, investigations and treatment outcomes on 5 cases of Superior Semicircular Canal Dehiscence.

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Dr Shankar Rangan SpR in Audiovestibular Medicine. Bolton PCT

SSCD was a relatively unknown and therefore an uncommon diagnosis till approx 10 years ago. In the more recent past, as a result of increasing awareness of the symptom complex, battery of investigations electrophysiological and radiological, and effective management, mainly surgical this is being identified more frequently. We identified 5 cases of SSCD in a 2 year period at our neuro-otology clinic in Bolton, which is not a designated tertiary unit. Three of the five patients (SF, CZ & LL) had additional problems that masked their SSCD symptoms. In terms of investigations, one (SF) had the full symptom complex with unequivocal evidence on the HR CT scan of the IAMs but the surgical and radiological findings did not tally. While treatment varied dependant on patient choice and symptom complex, so far three had surgical intervention. There was significant resolution of SSCD symptoms in one, > 50% in another but only approx 25% in the third. One patient opted not to have surgery and the last is awaiting this. This paper discusses these variations.